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-COMMUNIST CHINA-

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NEW CHINA'S ACTIVE DEVELOPMENTS IN SOIL SCIENCE

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Soil science has very broad applications. Not only does it supply source material for the development of agriculture and the reclamation of arid land but also its research is expected to aid in the expansion of forestry and livestock industries and the complex task of reconstructing nature.

Since time immemorial, research on soil has been recorded in Chinese history, and the vast farm population acquired rich production experince. However, because of prlonged feudalistic rule and due to the reactionary regime's disregard for soil conservation, soil science, although traditionally developed in China, was discontinued.

Prior to the liberation, limited research on soil conditions was undertaken but it was superficial. It was neither planned for all-out development nor pertinent to broad, serious research. Divorced as it was from factual situations, it contributed little to the solution of related production problems. The small appropriation set aside for research could not be depended upon; equipment was obsolete and elementary; personnel was limited and incompetent for serious work; and there was neither an independent institute for soil research nor any vital department of soil science in the higher schools. During the reactionary regime, soil science played an ornamental role and as such was of little consequence.

With the party and the people's government taking unlimited interest in scientific enterprise and under their correct leadership, soil science has developed greatly during the decade following the liberation. Projects and institutes for pedological research have been established across the country by Academia Sinica, the Ministry of Agriculture, the Ministry of Reclamation, the Ministry of Forestry, the Ministry of Hydroelectric Power and various provinces and municipalities. In the higher schools there are special departments of soil chemistry, and a network of

institutes of pedology has gradually taken shape across the land. The soil science brigade has expanded and, especially since 1958, its work has progressed rapidly under the incentive of the great leap forward and the brilliant guidance of the party's general line.

During the past decade of national construction work in soil science has been conducted mainly to meet the need for national economic construction. It has developed in line with the growth of socialist reconstruction. During this period not only has its scientific level been raised but in regard to scientific thinking, work methods, and organization there has been a great development. The achievements and experience of Academia Sinica in soil conservation during the past decade are given to illustrate the development of soil science in China.

I. Developmental Approach to Soil Science

Soil genesis is considered as a developmental approach to the study of soil science, which explains not only soil movement, change and development but also the transformation of soil on the basis of this developmental law. Before the liberation, this proper approach to soil science was not used. By learning incessantly the doctrines of Marx and Lenin and the advanced experience of the Soviet Union after its liberation, the developmental aspect of soil genesis gradually came to be established in the study of soil science in China.

During the past decade, besides accepting this approach to soil genesis for the purpose of soil calssification in China, we also conducted research on the laws governing soil development and transformation relevant to soil improvement. The formation of and interaction between brown soil (ho-t'u), meadow soil, swamp soil, and salty soil in the great plains of North China were also correctly expalined. It was pointed out that drought, flood and salinity of soil were the three important factors restraining agricultural production in this area. In this connection, proposals for improvement were made.

As to the improvement of red earth, research on its development and transformation was conducted and different methods were proposed and utilized in dealing with diverse types of red earth.

Chernozem found in Northeast China was generally understood to have gone through the meadow soil process. The verification of this developmental feature has contributed significantly to soil cultivation. Out of this approach to soil genesis laws governing distribution and

change in the formation of organic matter and mineral clay have emerged. Thus, not only have the basic characteristics of soil fertility been determined, but also a fairly deep understanding of the quality of soil itself has been made.

In the wake of the great leap forward and under the impetus of bumper agricultural production, /the people/ have been stimulated to improve soil activities, and using the developmental approach have, through thestudy of deep plowing, soil maturity and irrigation, brought about a transformation in the soil. Not only was the scope of soil genesis broadened but also a step forward was made in the development of soil genesis.

II. Over-all Examination of Soil Resources

After the liberation, not only was soil investigation conducted in such frontier regions as Heilungkiang, Sinkiang, Tibet, Yunnan and Hainan Island but soil research was carried on in mountainous forest areas and agricultural plains as well; and not only were route studies and the making of small-scale soil charts continued but also preparations for general and detailed soil surveys and for the making of large and medium-scale soil charts were undertaken.

To meet the demand for river valley planning, Academia Sinica collaborated with the departments of water conservancy concerened in organizing investigation groups to undertake large-sclae soil surveys in the Yellow River valley, Yangtse River valley, Sungari River valley and Liao River valley, and to complete medium-scale soil area charts.

During the past decade, combined investigation groups entrusted with the collection of material for soil improvement work were organized under the auspices of Academic Sinica, the scope of their activities ranged from Heilungkiang in the north and Sinkiang and Yunnan in the west to Kwangtung, Kwangsi and Hainan Island in the south.

With the substantiation of source material on soil structure, it was possible to explain major types of soil and their distribution in the various areas and also to understand the law of soil zonality in its horizontal and vertical aspects. This knowledge was used for the compilation of national soil charts and national soil zone maps.

Following the great leap forward, the masses were alerted to undertake a general soil survey across the country under the leadership of the Ministry of Agriculture. In the course of a year, 4.6 billion mou of land were covered in this survey, of which 1.3 billion mou of land were

tillable, accounting for 77 percent of the tillable area in China. Actively engaged in this task were various soil units of Academia Sinica. Under the unified leadership of local party committees which coordinated other units concerned, not only were soil charts for farm production purposes compiled for use by the people's communes and production brigades but also soil maps were prepared for various provinces and municipalities. This work was significant for its contribution to the development of farm production and the impact of soil research on cultivation.

III. Broadening Research on Soil Improvement

Embodied in a program for soil improvement was the reclamation of arid land and subproduction farms. For the transformation of vast tracts of saline land, soil investigation was conducted together with the study of underground water in order to understand the relationship between moisture factors and soil salinity and to act accordingly. With this in view, orientation tests were carried out in Shantung, Hopeh, Inner Mongolia, Kirin and Kiangsu to ascertain soil salinity.

By examining the causes of fertility and barrenness in red earth and by studying its developmental features, vast tracts of red earth land have been improved. Different samples of red earth were considered in the light of their environmental factors and combined measures for their utilization and improvement in respect to agriculture, forestry and livestock were adopted. It was revealed through these studies that if any farm crops were to flourish on red earth wasteland, phosphates as well as organic fertilizer should be employed.

The seriousness of erosion in the northeestern loess plateau region was reflected in dwindling local farm production and silting in the lower reaches of the Yellow River. An inspection group for water and soil conservation in the Northwest was organized with a view to studying systematically samples of and causes for, soil erosion in loess regions. Combined biological and engineering measures were adopted in some typical areas so that orientation tests might be made on water and soil conservation.

Areas blighted by sand dunes in Inner Mongolia and Liaoning Province were investigated and examined with a view to their improvement. Wind-protection and soil-consolidation tests were made at Chung-wei, Ninghsia Province, by the Ministry of Railways so as to maintain road conditions and to keep sand storms under control along the Pao-t'ou-

Lan-chou Line. Following the great leap forward, sand storm prevention brigades were organized to handle the work on a large scale.

Causes for subproduction and factors for soil development were studied with reference to subproduction paddy fields composed of frozen earth, chalk soil and black swamp earth and measures were taken for their improvement. In the case of innundated rice paddy fields, water was drained off and organic fertilizer applied. Soil productivity increased as the system of cultivation was improved.

IV. Research on Deep Plowing, Fertilization and Raising of Soil Fertility

Deep plowing and fertilization contributed significantly to the increase in soil fertility. After the great leap forward, a certain number of work squads were dispatched by Academia Sinica to various village centers to profit from their mass production experience. In deep plowing tests conducted by Comrade Ma Tung-i (7456 0681-5030) at Ch'ang-ko Hsien, Honan Province, preliminary results indicated that soil plowed to a depth of 20-30 centimeters and fertilized with organic matter was found to have matured more rapidly. Its porosity, permeability and aeration were noted to have been improved, while its water-absorption and conservation capacities were also increased to facilitate micro-organism activity and multiplication.

It was mainly due to the employment of organic fertilizer that bumper crops were harvested in 1958 throughout the country. The superiority of organic fertilizer, verified by research, was shown in its power to improve soil texture, its loosening influence, its aid to water culture, its activating effect on micro-organisms and its power to release nutritional matter incessantly. Humic acid was extracted from organic fertilizer, and through water culture and P^{32} tests it was established that humic acid had functioned as a plant growth stimulantor and an inorganic nutrition absorber. As to the properties of various organic fertilizers, it was further established that hog and sheep manure was superior to cow and horse excretions in that the humic acid of their fertilizer compost possessed a higher power coefficient with a higher content of phenolic humic acid. In treating soil with organic fertilizer, growth of farm crops was closely related to the amount of hydrolytic nitrogen the soil contained. Growth of wheat was normal when soil contained 4-5 milligrams of hydrolytic nitrogen per 100 grams of soil, but as soon as its content dropped below 3 milligrams a shortage of nitrogen was evi-

dent in the growth of the wheat.

To fully utilize phosphorus powder produced in China, systematic research on the chemical composition and the fertility coefficient of apatite mined in various parts of China was conducted. With acid soil the effectiveness as a fertilizer varied with different types of apatite but the fertilizing effect of phosphorus powder on soil was increased when it was used with green manure cultivation because of a higher capacity for absorption.

V. Adoption of New Techniques for the Promotion of Basic Theoretical Research

Work in the soil sciences in New China stresses not only the unification of production practices, but also theoretical penetration; not only unified progressive investigation and research, but also diversified specialized research, as well as the supplementing and rebuilding of studies [now] weak or barren. As to basic theoretical research on soil, apart from conducting organized research on its physical, chemical and biological aspects, many new techniques such as the X-ray, radiation spectrum, absorption spectrum, color spectrum and isotopic and precision electrical and chemical appliances should be made available for research on soil science.

As to soil physics, the main interest lies in the summarization of mass experience in order to discover by scientific tests the physical indexes for soil tilth and fertility, in research on drought prevention and in understanding the techniques of dam protection and of irrigation development. By means of X-ray and calorie analyses and absorption measurements, a preliminary understanding of such clay minerals in China as grey-brown desert soil, sierozem, grey-brown soil, yellow-brown soil and their principal derivatives, such as "i-li" rock, kaolinite and laterite (gibbsite and hemitite), can be reached. The exchange capacity of black clay in northeast China was equivalent to 50-60 milligrams per 100 grams of black earth; that of grey-brown clay in northwest China was equal to 30-40 milligrams; and that of red clay in south China was equivalent to 10-20 milligrams.

Some research was done on the influence of soil colloids on the fixation and release of phosphate of potash. Red earth in south China contained a sizable amount of active iron and aluminum, which served usefully as a phosphoric acid fixing agent; non-exchangeable potassium found in chernozem of northeast China and grey-brown earth

of northwest China could be made exchangeable. It was mainly due to aluminum ions that exchangeable hydrogen was found in the acid soil of south China. The exchangeable hydrogen ion could be speedily replaced by the aluminum ion. It was also established that the amount of exchangeable hydrogen would be greatly reduced in soil higher than pH5.5, for it would only start to increase in soil with a higher concentration of organic matter. In rice paddy soil it was mainly the presence of "hydrogen" that determined the reduction of electric potential by oxidation when electric potential was rated high, but when it was low the determining role was assumed mainly by the "organic component". Generally speaking, iron was not a determining factor in electric potential. The state of iron and manganese changed as the electric potential in rice paddy soil was changed but manganese recovered more easily than iron.

Systematic research on organic soil proved that the relationship between soil factors and the composition of soil humus as found in the calcareous soil of northeast and north China generally conformed to the geological law of humus formation. In the case of strong acidic red and yellow earth as identified in South China, the concentration of humic acid was low; its composition was simple and its condition unstable. The phenolic acid content was, however, high.

In regard to soil micro-organisms the use of bacterial fertilizer was fairly great, while work progressed on the formation and distribution of soil micro-organisms and the contribution of fertilization and irrigation measures to the development and activity of micro-organisms.

VI. Unify Production Practices, Develop Scientific Research

To unify production tasks, develop scientific work, and engage in penetrating theoretical research, are an important path for the rapid growth of scientific enterprises. Data on salty soil and underground water were collected in planning for soil investigation in river valleys and research was conducted on soil genesis and transformation in the plain regions. The law of sedimentation on the alluvial plain was clarified somewhat. In order to develop tropical economic plant resources, broad soil investigation and study carried out in vast areas of south China. Not only was soil over a vast tract of land made available for the planting of rubber trees and other economic plants but also research on soil chemistry and minerals with reference to the developmental features of red earth was conducted.

Studies on soil chemistry, soil biochemistry and soil micro-organisms were pursued with a view to establishing the superiority of organic fertilizer. Not only was the chemical change in the nutritional matter of the farm compost examined but also the transformation and composition of organic matter at various stages of humification and various types of organic fertilizer, with special emphasis on humic acid, were studied in great detail.

In the course of general soil investigation, stress was placed on the experience of the masses in classifying soil. On the basis of this study of soil genesis, soils were grouped systematically. Surveys were also made to establish scientific indexes on the extent of soil tilth and maturity as identified by the masses. The above-mentioned instances fully support the fact that the effective approach to the development of soil science in China lies in unifying production practices and in gathering together the experiences of the masses and raising them to /the level of/ scientific theory.

After the liberation, the intellect of the proletariat triumphed over that of the capitalist class in the struggle /between the two classes/. By a series of political movements, especially the rectification and the anti-Rightist struggle, the political thinking and consciousness of scientific personnel was elevated and a desire to make science serve the socialist reconstruction gradually arose.

After the great leap forward, studies on rational utilization and improvement of soil, deep plowing, and fertilization were intensified, man's subjective potentialities were exploited, and soil improvement progressed, When our knowledge of soil is utilized in its transformation, soil science is bound to gain in vitality and a broad path will be blazed for the development of soil science in China.

VII. To Follow the Mass Line and Work Collectively

Following the liberation, soil science activities as embodied intthe plan for national economic construction were both numerous and urgent. The needs of the nation and the people cannot be satisfied if /too/ few people using a comparatively large amount of time are to carry out /these/ tasks. To activate the masses to perform tasks in common is a good method but the masses should be closely controlled. There should be not only identity in thinking but also unity in operation and specification. Such collective scientific effort could prevail only under a socialist system. In one situation, planning for an investigation of

soil in a river valley, 400-500 workers were mobilized to undertake the project. Not only was the task accomplished within a short period of time but also scientific data were systematically collected and compiled. Indoor scientific pursuits were likewise performed collectively and soil scientists were gathered to participate in the work both collectively and individually, all working toward the same objective. There was a gain not only in coordinated effort but also in mutual enlightenment and advancement.

To facilitate research on more important problems such as the superiority of organic fertilizer, not only were soil science workers gathered but also those interested in such related subjects as plant biology, micro-organisms and atomic energy were asked to participate in deliberations and studies.

After the great leap forward, soil science research work was conducted along the mass line while the workers themselves participated actively in the mass soil investigation movement, and at the village centers evaluated their bumper crop production experiences. Not only was mental labor coordinated with physical labor but also science workers were able to acquire production skills from the masses, to promote and raise the standard of soil science in the vast village areas and to train many farm technicians. Research on soil science is urgently needed for stepping up farm production over the vast area of China. The farm population of China should be incited to advance toward soil science /based on/ farm production so that its growth can be accelerated in time to satisfy the people's production needs.

VIII. To Unify Work and to Train Large Groups of Cadres

In early period of the liberation, soil science workers in Academia Sinica were very limited in number. Not only were they incompetent to cope with the work of soil science for national economic construction but also the growth of soil science in China was retarded. To train young cadres was, therefore, accepted as a key task at the very outset. During the past decade the soil brigade of Academia Sinica had gradually expanded. Compared with the early post-Liberation period, there are now more than 20 times as many soil science workers. In training cadres for this work, experience has proved that the most effective method is to put those trainees who have acquired a basic knowledge in collective training to step up their advancement in techniques as well as to solidify their political

thinking and organizational activity so that they may move steadily along the "red" and "specialized" path.

Collective cultivation in practical work, correct understanding of objectives and great promotional effort have contributed not only to the exchange of experience and mutual learning but also to mutual enlightenment and supervision. In preparing a work schedule, the idea of cultivating cadres should be planned so as to fully develop the mass line, to place confidence in the masses, to develop constantly interest in enlightenment, to stimulate zeal for work, to foster independent thinking, to face difficulty without fear and to advance step by step. There should be adequate encouragement as well as criticism during /training/ operations. It was established by fact that the cadres who were trained and forged in practical work reached maturity faster and could face real situations with greater courage. Research personnel trained after the liberation could lead more than 100 workers in group investigation work and graduates with 5-6 years' experience were known to have led groups of more than 20 people in scientific work. Even research trainees with 1-3 years' graduate experience were observed to have developed their capacity for collective organization and to have completed their reports collectively.

While continuing to cultivate graduate and professional trainees, stress was placed on the training of secondary school students in practical work on the one hand and in planned organizational experience on the other. After such training some secondary school students already headed committees in soil investigation work, and some even produced reports on the strength of the scientific data derived from mass experience in the rural area. In addition, training classes were held at public organizations and villages for the benefit of large groups of cadres, teachers and students that were engaged in smiilar work.

The training of cadres should be comprehensive so that they can not only read, write and act indoors and outdoors but also and especially engage in operational /career/ as well as political activities as "red" and "specialized" cadres. In view of the new formula for soil science work along mass and collective lines, the political horizon of our workers should be so extended as to merge with the masses in collective experience and living and in developing a capacity for collective scientific work.

As for the new techniques applied to soil science, the cadres should be disciplined accordingly. Only by following the mass line in conducting scientific research

work can large groups of cadres be cultivated to meet the nation's present and future requirements, and only by acquiring this new strength can our future development in soil science be assured.

During the decade after the liberation, there has been great development in China in soil science work, and this development was particularly rapid in the first one or two years after the great leap forward. All this fully demonstrates the superiority of the socialist system under the excellent direction of the Chinese Communist Party, besides proving the effectiveness of promoting soil science along the general line and in keeping with the great leap forward.

In reviewing the growth of soil science during the past decade, while deeply recognizing the correctness in scientific guidance of the Chinese Communist Party, thanks are also due to the selfless aid given by the Soviet Union and other brother states.

We are fully confident that by pursuing anti-Rightism thoroughly, by stimulating effort and by continuing the great leap forward soil science work will lead to greater achievements in China.

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